



Effect of Dwell Time on the Mental Health of U.S. Military Personnel With Multiple Combat Tours

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Effect of Dwell Time on the Mental Health of US Military Personnel With Multiple Combat Tours

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Military deployment has long been recognized as a stressor because it removes individuals from the comfort of home and can strain relationships with spouses and other family members.^{1,2} The number of combat deployments increases during times of military conflict, as was the case in the years following the events of September 11, 2001. With the initiation of Operation Enduring Freedom (OEF) in October 2001 and Operation Iraqi Freedom (OIF) in March 2003, the pace of military operations increased markedly and many service members experienced multiple deployments to the combat zone.³ The cumulative health-related effects of multiple combat deployments are not well understood and are an emerging public health problem.

Multiple studies have identified an increase in mental health morbidity following a single deployment.^{4–7} Research on the mental health effects of multiple deployments, however, is limited. In 2007, the Mental Health Advisory Team (MHAT) found that soldiers on their third or fourth deployment in support of OIF had a significantly higher risk of mental health and work-related problems than did soldiers on their first or second deployment.⁸ Other studies have also identified increases in mental health symptoms, particularly symptoms of posttraumatic stress disorder (PTSD), among personnel preparing for and after their second OIF deployment.^{9,10} One study of British military personnel found that a higher prevalence of mental health symptoms was associated with deployment length but not with frequency of deployments.¹¹ The most recent MHAT report was the first to provide evidence suggesting a protective effect of dwell time (or the period of time at home between deployments) on self-reported adverse mental health symptoms, though actual medical utilization was not examined.¹²

Dwell time and multiple deployments have also been the subject of recent media reports. Secretary of Defense Robert Gates and Senator Jim Webb recently called for establishing

Objective. We investigated the association of the length of time spent at home between deployments, or dwell time, with posttraumatic stress disorder (PTSD) and other mental health disorders.

Methods. We included US Marine Corps personnel identified from military deployment records who deployed to Operation Iraqi Freedom once ($n = 49\,328$) or twice ($n = 16\,376$). New-onset mental health diagnoses from military medical databases were included. We calculated the ratio of dwell-to-deployment time (DDR) as the length of time between deployments divided by the length of the first deployment.

Results. Marines with 2 deployments had higher rates of PTSD than did those with 1 deployment (2.1% versus 1.2%; $P < .001$). A DDR representing longer dwell times at home relative to first deployment length was associated with reduced odds of PTSD (odds ratio [OR] = 0.47; 95% confidence interval [CI] = 0.32, 0.70), PTSD with other mental health disorder (OR = 0.56; 95% CI = 0.33, 0.94), and other mental health disorders (OR = 0.62; 95% CI = 0.51, 0.75).

Conclusions. Longer dwell times may reduce postdeployment risk of PTSD and other mental health disorders. Future research should focus on the role of dwell time in adverse health outcomes. (*Am J Public Health.* 2012;102:S55–S59. doi:10.2105/AJPH.2011.300341)

minimum requirements for time at home between deployments.^{13,14} A variety of factors can influence the determination of a service member's dwell time, including current operational needs and unit rotation schedule. In our study, we aimed to identify new-onset mental health diagnoses among US Marines with 1 and 2 OIF deployments. Among those with 2 OIF deployments, we examined the association of dwell time with PTSD and other mental health disorders. We hypothesized that increased dwell time relative to first deployment length would be associated with lower rates of adverse mental health outcomes.

METHODS

We used electronic military deployment records from the Defense Manpower Data Center (DMDC) to identify the study population. US Marine Corps personnel with 1 and 2 OIF deployments, identified as deployment to Iraq or Kuwait between January 2003 and December 2007, were included in the analysis. For the purposes of our study, we defined

a deployment as lasting between 1 and 18 months. The study population was further restricted to those with deployments between 4 and 8 months, which encapsulated the interquartile range of all deployed personnel. A total of 65 704 deployed personnel met this criterion (representing 71% of all deployments). Exclusion criteria were Reserve or National Guard status (because of the potential for differential access to medical care), personnel with any deployment to a non-OIF location, women (because of the small sample size), and those with previous mental health diagnoses before the first or second deployment identified from inpatient and outpatient medical databases. This study was approved by the institutional review board at the Naval Health Research Center, San Diego, California.

Measures

We calculated length of deployment from DMDC records as the difference between the start and end dates of deployment. For those with 2 deployments, we calculated dwell time by subtracting the start date of the second

deployment from the end date of the first deployment. We then calculated the dwell-to-deployment time ratio (DDR) as the length of time between deployments divided by length of the first deployment and categorized this variable into the following 3 ratios: less than 1:1, 1:1, or 2:1. The less than 1:1 ratio represents a shorter dwell time or time spent at home than deployed, 1:1 represents as much dwell time as deployed, and the 2:1 ratio represents longer dwell times (at least 2 times longer) relative to the length of the first deployment. We conducted an additional analysis by using the continuous form of DDR.

We identified provider-diagnosed mental health disorders from inpatient and outpatient military medical databases. The observation period for those with 1 or 2 deployments was the duration of deployment plus 1 year. A mental health disorder was indicated by the presence of an inpatient or outpatient *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*¹⁵ code in the range of 290 to 319. Outcome was categorized into PTSD (*ICD-9-CM* 309.81) and other mental health disorder (all other mental health disorder *ICD-9-CM* codes, excluding 305.1, tobacco addiction), and the PTSD group was further dichotomized into PTSD only and PTSD with other mental health disorder. The other mental health disorder category included mood disorders (*ICD-9-CM* 296, 300.4, 301.13, 311), anxiety disorders (*ICD-9-CM* 300.00–300.02, 300.21–300.29, 300.3, 308.3, 308.9), adjustment disorders (*ICD-9-CM* 309.0–309.9, excluding 309.81, PTSD), substance-abuse disorders (*ICD-9-CM* 291, 292.0–292.1, 292.3–292.9, 303, 304, 305.0, 305.2–305.7, 305.9), and other (other *ICD-9-CM* codes between 290 and 319 not previously listed). For those with 2 deployments, we used inpatient medical databases to identify those with a hospitalization during their first deployment, because this could affect dwell time.

We abstracted age and military rank from DMDC records. Age was assessed as a continuous variable and rank was categorized into junior enlisted (E1–E5), senior enlisted (E6–E9), and officer or warrant officer. For those with 2 deployments, age and military rank at the time of second deployment were used in the analysis.

Statistical Analysis

We performed descriptive analysis for characteristics of personnel with 1 and 2 deployments. Crude rates of PTSD and other mental health disorders were calculated, stratified by number of deployments, and compared with chi-square testing. Dwell time was analyzed with DDR calculated in both its continuous and categorical form. The distributions of DDR and other deployment-specific variables were compared by using Wilcoxon testing across outcome groups. Rates of PTSD and other mental health disorders were compared across different DDR categories, and Mantel-Haenszel testing was used to assess for trend. We conducted polychotomous logistic regression to evaluate the odds of PTSD and other mental health disorders with adjustment for covariates, and we evaluated a separate model excluding personnel with a hospitalization during their first deployment.

RESULTS

The study population consisted of 49 328 Marines deployed once and 16 376 deployed twice to OIF. Descriptive information for the study population is listed in Table 1. For those with 2 deployments, median days of both the first and second deployment (203 and 205 days, respectively) were similar to the median deployment length for those with 1 deployment

(203 days). The distribution of DDR was heavily skewed to the right, with a median of 1.7 (interquartile range = 1.2–2.3), approaching the DDR category of 2:1 with longer dwell times relative to first deployment length. Overall, 80% of those with 2 deployments were home for at least as long as the length of their first deployment.

Rates of mental health disorders are detailed in Table 2. The overall rate of PTSD and other mental health disorders was 1.5% and 6.1%, respectively, with higher rates of PTSD among personnel with 2 deployments compared with those with 1 deployment (2.1% versus 1.2%) and, conversely, higher rates of other mental health disorders among those with 1 deployment compared with 2 (6.3% versus 5.7%). A breakdown of the other mental health disorder category indicates substance abuse disorder as the most common subcategory, with higher rates among those with 1 deployment than among those with 2 (2.4% versus 1.7%). Similarly, mood disorders were slightly higher among those with 1 deployment.

For those with 2 deployments, we calculated the distribution of DDR and other deployment-specific variables stratified by outcome category (PTSD diagnosis only, other mental health disorder, PTSD with other mental health disorder, and no mental health disorder). The details of these distributions are shown in Table 3. Median DDR differed significantly

TABLE 1—Demographic Characteristics of US Marines with 1 and 2 Deployments to Operation Iraqi Freedom (N = 65 704): 2003–2007

Characteristic	1 Deployment (n = 49 328)	2 Deployments (n = 16 376)
Age, y, median (range) ^a	22 (17–57)	22 (19–53)
Military rank, no. (%) ^a		
E1–E5	40 762 (82.6)	13 363 (81.6)
E6–E9	4923 (10.0)	1818 (11.1)
Officer or warrant officer	3643 (7.4)	1195 (7.3)
Time, d, median (range)		
First deployment	203 (120–240)	203 (120–240)
Second deployment	...	205 (120–240)
Dwell-to-deployment ratio, median (range)	...	1.7 (0.1–11.8)
Dwell-to-deployment ratio, no. (%)		
< 1:1	...	3270 (20.0)
1:1	...	8041 (49.1)
2:1	...	5065 (30.9)

^aFor those with 2 deployments, age and military rank at the beginning of the second deployment were used.

TABLE 2—Percentage of New-Onset Mental Health Disorders Among US Marines With 1 and 2 Deployments to Operation Iraqi Freedom: 2003–2007

Disorder ^a	1 Deployment (n = 49 328), No. (%)	2 Deployments (n = 16 376), No. (%)	P
Posttraumatic stress disorder (PTSD)	609 (1.2)	347 (2.1)	< .001
PTSD only	333 (0.7)	225 (1.4)	< .001
PTSD with other mental health disorder	276 (0.6)	122 (0.7)	.01
Other mental health disorder	3094 (6.3)	936 (5.7)	.01
Mood disorder	535 (1.1)	136 (0.8)	.01
Substance abuse disorder	1177 (2.4)	284 (1.7)	< .001
Adjustment disorder	604 (1.2)	227 (1.4)	.11
Anxiety disorder	434 (0.9)	161 (1.0)	.23
Other	838 (1.7)	243 (1.5)	.06

^aDiagnostic categories were not mutually exclusive; patients could be counted in more than one category.

across outcome groups ($P < .001$); those with PTSD only and PTSD with other mental health disorder had the lowest DDR (1.5), demonstrating shorter dwell times relative to first deployment length, and those with no mental health disorder had the highest DDR (1.7), or longer dwell times at home relative to time spent on first deployment. Those with no mental health disorder also had the highest first and third quartile values for DDR, as shown by the interquartile range (1.3–2.3). The results were similar for the continuous form of dwell time; those with PTSD only and PTSD with

other mental health disorder had the lowest median dwell times (296 and 298 days, respectively), and those with no mental health disorder had the highest median dwell time (342 days). Length of first deployment differed significantly across outcome groups ($P = .007$).

A summary of the DDR and mental health analysis is presented in Table 4. A high DDR of 2:1, representing a longer dwell time relative to first deployment length, was associated with a significantly lower rate of PTSD diagnosis only (0.9% versus 1.8%) and PTSD with other mental health disorder (0.5% versus 1.0%)

when compared with a low DDR or shorter dwell time ratio of less than 1:1. Rates of other mental health disorders were also significantly lower among those with a high DDR (2:1, 4.3%) versus a low DDR (less than 1:1, 7.1%). The Mantel–Haenszel test indicated a significant trend across DDR categories for PTSD only ($P < .001$), PTSD with other mental health disorder ($P = .01$), and other mental health disorder ($P < .001$). After adjustment for age and military rank in the polychotomous logistic regression, a DDR of at least 2:1 was strongly associated with reduced odds of PTSD only (OR = 0.47; 95% CI = 0.32, 0.70), PTSD with other mental health disorder (OR = 0.56; 95% CI = 0.33, 0.94), and other mental health disorders (OR = 0.62; 95% CI = 0.51, 0.75) when compared with the low DDR category (less than 1:1). DDR was also analyzed as a continuous variable where longer dwell time at home relative to first deployment length was associated with reduced odds of PTSD only (OR = 0.80; 95% CI = 0.70, 0.93), PTSD with other mental health disorder (OR = 0.75; 95% CI = 0.61, 0.93), and other mental health disorder (OR = 0.87; 95% CI = 0.82, 0.93). The results did not change after the exclusion of personnel with a hospitalization during their first deployment ($n = 36$). In addition, a separate adjustment for age at first deployment did not affect the results.

TABLE 3—Distributions of Deployment-Specific Variables Stratified by Outcome Category Among US Marines with 2 OIF Deployments: 2003–2007

Deployment Variable	PTSD Only (n = 225)	PTSD With Other Mental Health Disorder (n = 122)	Other Mental Health Disorder (n = 936)	No Mental Health Disorder (n = 15 093)	P ^a
DDR					< .001
Median (range)	1.5 (0.6–9.5)	1.5 (0.4–3.8)	1.6 (0.1–11.2)	1.7 (0.1–11.8)	
Interquartile range	1.0–1.9	0.9–1.9	1.0–1.9	1.3–2.3	
1st deployment time					.007
Median (range)	207 (120–240)	206 (120–238)	205 (120–240)	203 (120–240)	
Interquartile range	185–212	188–212	182–211	175–212	
2nd deployment time					.053
Median (range)	206 (132–240)	206 (124–228)	205 (120–240)	205 (120–240)	
Interquartile range	202–212	201–209	198–210	195–210	
Dwell time					< .001
Median (range)	296 (132–1172)	298 (100–770)	314 (29–1360)	342 (24–1425)	
Interquartile range	206–367	206–370	206–367	220–412	

Note. The sample size was $n = 16\,376$. DDR = dwell-to-deployment ratio; OIF = Operation Iraqi Freedom; PTSD = posttraumatic stress disorder.

^aWilcoxon test for difference across medians.

DISCUSSION

This study provides the first preliminary evidence linking dwell time spent at home to subsequent postdeployment mental health diagnoses. There has been much discussion on setting a dwell time policy, that is, a standard length of time military members must be home before consideration for their next deployment. Although further research is needed to elucidate the potential protective effect of dwell time, the results of the present study advance the discussion on the utility and potential effectiveness of regulating dwell time.

The rates of PTSD and other mental health disorders that we reported were consistent with previous research, as was the finding that only PTSD rates were elevated in personnel with 2 deployments. Larson et al. found similar rates among deployed US Marines, although when compared with a nondeployed

TABLE 4—Mental Health Diagnoses Among US Marines with 2 OIF Deployments by Dwell-To-Deployment Time Ratio (DDR): 2003–2007

DDR ^a	Total (n = 16 376)	PTSD Only		PTSD With Other Mental Health Disorder		Other Mental Health Disorder	
		No. (%) ^b	OR (95% CI) ^c	No. (%) ^d	OR (95% CI) ^c	No. (%) ^b	OR (95% CI) ^c
< 1:1 (Ref)	3 270	60 (1.8)	1.00	32 (1.0)	1.00	233 (7.1)	1.00
1:1	8 041	122 (1.5)	0.83 (0.60, 1.13)	64 (0.8)	0.82 (0.53, 1.25)	485 (6.0)	0.84 (0.72, 0.99)
2:1	5 065	43 (0.9)	0.47 (0.32, 0.70)	26 (0.5)	0.56 (0.33, 0.94)	218 (4.3)	0.62 (0.51, 0.75)

Note. CI = confidence interval; OR = odds ratio; PTSD = posttraumatic stress disorder.

^aDefined as the period of time at home between deployments divided by the length of first deployment.

^bMantel-Haenszel test for trend: $P < .001$.

^cORs and 95% CIs were calculated by using polychotomous logistic regression with adjustment for age and military rank.

^dMantel-Haenszel test for trend: $P = .01$.

control group, only PTSD was significantly higher.¹⁶ Those authors identified the “healthy warrior effect” as a possible explanation, that is, the overall healthier status of personnel who deploy compared with those who do not, and the results of the present study suggest an extension of that effect to personnel with 2 deployments compared with 1.^{16,17} It is possible that disorders perceived as more serious, such as depression and bipolar disorder, become disqualifying conditions and therefore prevent the service member from subsequent deployments. As such, those with multiple deployments may represent a more resilient population. This may be supported by the marginally significant finding in the present study of lower rates of other mental health disorders among personnel with 2 deployments.

The primary findings of our study suggest that longer dwell times are associated with lower odds of mental health diagnoses, which is consistent with a stress–exhaustion model in which the cumulative effects of multiple deployments eventually lead to higher mental health morbidity.¹⁸ This effect has been shown in multiple studies of OIF combat populations.^{8–10} The opposite relationship, however, has been identified following multiple peacekeeping deployments.¹ Two recent studies identified a correlation between multiple deployments and increased mental health symptom reporting, but did not address the effect of dwell time.^{9,10} Although the theory behind the stress–exhaustion model is based on stressor duration, lack of an adequate dwell time may prevent the service member from fully recovering from the first deployment, which suggests that a mental “reset” period is

needed before subsequent deployment. This is supported by the most recent MHAT survey among US Army personnel, in which it was found that increased dwell time resulted in a steady decline in self-reported mental health problems.¹²

Future studies on dwell time should focus on characterization of the dwell time variable. For the purposes of our study, we placed dwell time over first deployment length to create a unitless measure of DDR. This ratio measure was skewed and subsequently categorized to reflect time at home relative to first deployment length. This methodology was a strength of our study because it used the current political language to characterize dwell time, thus making it more applicable to future policy decisions. For example, Senator Jim Webb’s dwell time proposal called for the establishment of a 1:1 DDR for all military personnel.¹³ Alternatively, Secretary of Defense Robert Gates called for the establishment of an immediate 1:1 DDR for specific units (e.g., brigade combat teams with typically high levels of combat exposure), with an eventual progression to a DDR of 2:1.¹⁴ It is possible, however, that there are other ways of exploring the relationship between dwell time and postdeployment mental health, including examining different inflection points, as well as more complex interactions with deployment length.

Other strengths of our study include the use of electronic deployment records that allowed for a large and robust study sample. At least one previous study found a high correlation between self-reported deployment dates and DMDC electronic records.¹⁹ The use of

electronic deployment records also allowed us to exclude personnel with previous non-OIF deployments, which removed potential confounding or mediating effects of other combat tours with differing deployment experiences (e.g., OEF) and noncombat tours (e.g., peacekeeping missions).

The limitations of the present study include the use of electronic medical databases for ascertainment of mental health diagnosis. This methodology likely resulted in an underestimate of mental health morbidity because stigma often prevents military personnel from presenting for care. Thus, mild cases of mental health disorder may be underrepresented. In addition, unmeasured variables may have affected the results of the study. Combat exposure, a mediator of the relationship between deployment and mental health, was not measured.^{20,21} Many life and work-related experiences during a service member’s dwell time, such as advances in rank, onset or dissolution of personal relationships, and changes in financial status, may also mediate the relationship between dwell time and mental health.

In conclusion, increased dwell time relative to first deployment length was associated with reduced odds of both PTSD and other mental health disorders. Combined with operational and logistical considerations, the findings of the present study may be useful in guiding future policy decisions on multiple deployments and dwell time. These results also highlight the importance of further research on dwell time, especially because multiple deployments are likely to continue for the foreseeable future. Future studies should incorporate self-report measures of mental health status, attempt to document specific dwell time experiences, examine effects on military attrition, and extend the population to those with 3 or more deployments. Furthermore, more extreme deployment lengths should be assessed. Many personnel experiencing multiple deployments will eventually transition to civilian life. As such, the cumulative health effects of multiple deployments present an emerging public health problem for the military, as well as for the general population. For present and future military conflicts, dwell time policies should focus on evidence-based decision making and work toward amelioration of the overall health of the US Armed Forces. ■

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Contributors

A. J. MacGregor led the study conception and design, analyses and interpretation of data, drafting of the article, and approval of the final version. P. P. Han contributed to the data analyses, revision of the article, and approval of the final version. A. L. Dougherty contributed to the study design, interpretation of data, revision of the article, and approval of the final version. M. R. Galarneau assisted with study conception, revision of the article, and approval of the final version.

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Human Participant Protection

This research was conducted in compliance with all applicable federal regulations governing the protection of human subjects in research and was approved by the institutional review board, Naval Health Research Center, San Diego, CA (protocol no. NHRC.2003.0025).

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14. ABSTRACT (maximum 200 words) Background: Operation Iraqi Freedom (OIF) required the use of military personnel for multiple combat deployments. Dwell time, or the period between deployments, may confer a protective effect against deployment-related mental health disorders, such as posttraumatic stress disorder (PTSD). Methods: U.S. Marine Corps personnel who deployed in support of OIF once and twice were identified from electronic military deployment records. New-onset mental health diagnoses (ICD-9-CM 290–319), including PTSD, were identified from inpatient and outpatient medical databases. For those with two deployments, dwell-to-deployment ratio (DDR) was calculated as the length of time between deployments divided by the length of first deployment. Results: Overall, rates of PTSD were higher among Marines with two deployments, though there was no similar association with other mental health disorders. Among those with two deployments, increased DDR was associated with lower rates of PTSD and other mental health disorders after adjusting for age and military rank. Conclusions: The present study provides evidence that longer dwell time between deployments may protect against PTSD and other postdeployment mental disorders. Because current operational tempo necessitates multiple deployments, future research should focus on the role of dwell time in adverse health outcomes, and the feasibility and impact of future dwell-time policies.													
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